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Growth of Manufacturing Capital, 1880-1948

The development of manufacturing industries is a familiar story in terms of output and employment,²² and the broad outlines of the story are not altered when it is told in terms of the stock of capital. For this reason we show only two measures of the development of manufacturing industries since 1880. One is a measure of the annual rate of change between benchmark years of book value of total capital expressed in 1929 prices in all manufacturing industries and in the 15 major groupings (Chart 1 and Table 4).

TABLE 4

Dates of Troughs and Peaks in Secular Swings in Gross National Product per Worker and in Total Capital in All Manufacturing Industries (1929 Prices), 1873-1948

<i>Level</i>	<i>GNP per Worker (1)</i>	<i>Total Manufacturing Capital (2)</i>	<i>Annual Rate of Change (geometric average, %) (3)</i>
Trough	1873		
Peak	1884	1880-1890	+8.8
Trough	1892	1890-1900	+5.3
Peak	1903	1900-1904	+6.5
Trough	1912	1909-1914	+3.0
Peak	1926	1914-1919	+4.6
Trough	1932	1929-1937	-1.6
Peak	1945	1937-1948	+3.7

Source:

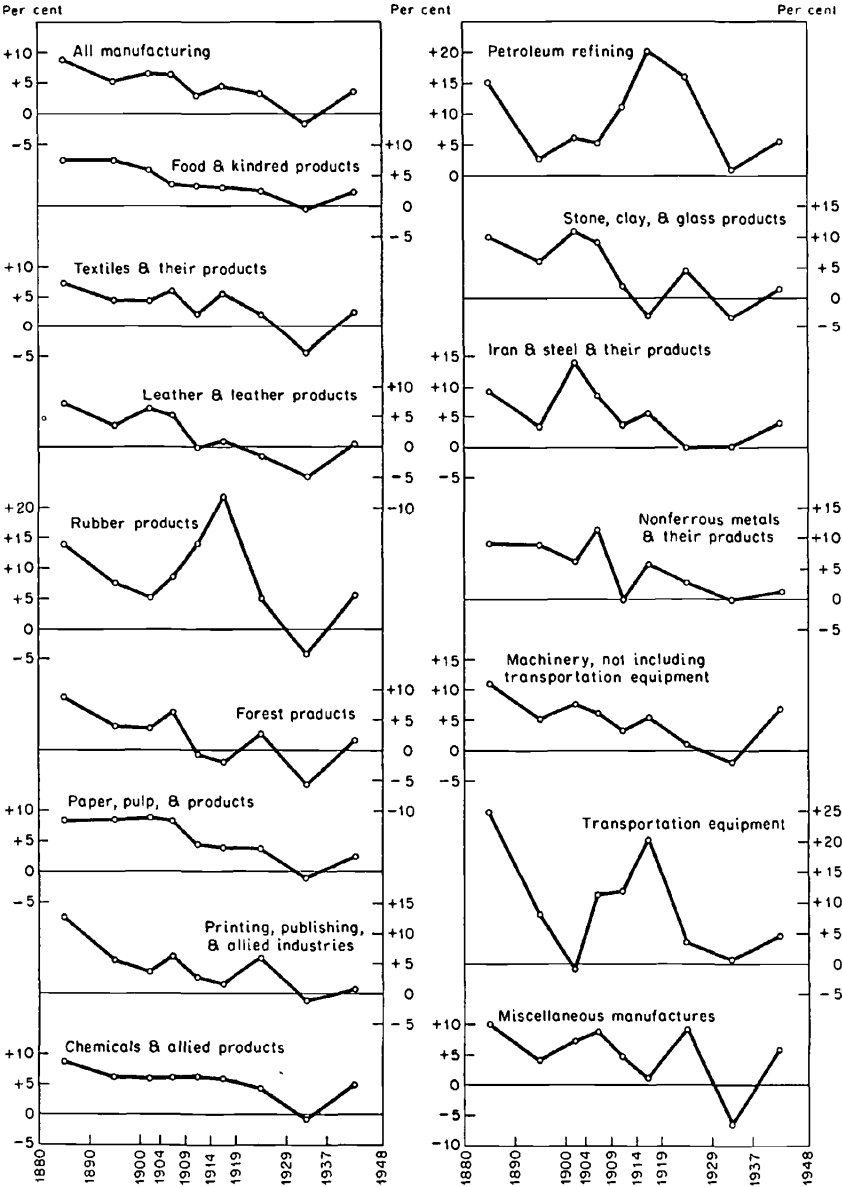
Column 1 Simon Kuznets, "Swings in the Rate of Secular Growth," Work Memorandum No. 37, p. 19, Table 6 (mimeographed, National Bureau of Economic Research, March 1952).

2 & 3 Table 5 of this paper.

²² See, for example, two monographs by Solomon Fabricant, *The Output of Manufacturing Industries, 1899-1937* and *Employment in Manufacturing, 1899-1939* (National Bureau of Economic Research, 1940 and 1942, respectively).

CHART 1

Annual Average (Geometric) Rate of Change
in Total Capital (1929 Prices) between Benchmark Years
All Manufacturing and Fifteen Major Manufacturing Industries, 1880-1948



As one would expect, the highest annual rate of growth (geometric average) of the stock of manufacturing capital occurred during 1880-1890, the first decade covered by the statistics, when modern manufacturing in general was emerging from its earlier beginnings, although some part of this rise must be attributed to the under-reporting of capital in 1880. The annual rate of growth has tended to decrease as we approach the present period.²³ However, it would be wrong to infer from this that the rate of growth decreases continuously and never reverses itself. Certainly, in the case of the stock of capital there have been alternating periods of relatively high and low rates of increase. The downward drift results from the fact that each succeeding peak rate and each succeeding trough rate are at lower levels.

The dating of these alternating periods cannot be determined precisely with our data since we are restricted to average annual percentage changes between benchmark years. Despite this crudity, the evidence suggests that the alternating periods of relatively high and low rates of increase in capital stock coincide with relatively high and low rates of increase in the economy's output as measured by gross national product (GNP) per worker in 1929 prices (Table 4). The noncoincidence of the 1926 peak in GNP per worker and the relatively high rate of manufacturing capital in 1914-1919 is more apparent than real. If the latter figure for 1914, for example, were extrapolated by Chawner's estimates of capital expenditures for manufacturing plant and equipment in constant prices for the years 1915-1940,²⁴ the long-term peak based on a nine-year moving average computed from the resulting annual estimates would appear in 1926.

The existence of alternating periods of relatively high and low rates of change in the capital stock is another complicating factor in any projection of the current rate of growth into the future. It is essential that the estimator establish whether the current rate represents a relatively high or low position in the long swings in accumulated capital.

How pervasive is this pattern of alternating periods of high and

²³ If we assume that the capital estimates are more and more net of depreciation as we move forward from 1880 to 1919, this would have a damping effect on the rate of growth; if the opposite has been true, which we doubt, the rate of growth has been exaggerated.

²⁴ *Survey of Current Business*, March 1941, p. 11.

low rates of expansion? Is the pattern for total manufacturing capital a result of averaging diverse or similar chronologies? An answer is suggested by comparing the chronology of the long swings in each of the 15 major groups with the chronology for all manufacturing industries (Tables 5 and 6). A date in parentheses indicates that the turning point for a given industry group differs from that for all manufacturing.

In only 2 of the 15 major industry groups, leather and leather products and machinery, are the chronologies of the secular swings identical with the one for all manufacturing. Differences in timing occur most frequently between 1890 and 1919. Only two industry groups failed to show a peak rate of growth between 1880 and 1890, and only one failed to show a low rate of change between 1929 and 1937. On the other hand, all industry groups developed at a relatively high rate between 1937 and 1948. Extended swings due to prolonged expansions occurred in two industry groups related to the revolution in road transportation: transportation equipment, which includes automobiles, and rubber products. In these industries expansion was initiated in 1900-1904 and continued until 1914-1919. Other groups that reached a peak during the World War I period rather than in the twenties were petroleum refining, the metal industries, textiles, and leather products — all industries in which substantial military orders were added to regular civilian demands. Those groups closely connected with building construction — such as forest products and stone, clay, and glass products — were depressed during World War I, since these activities had a low priority, but were booming during the twenties when restrictions were removed.²⁵

Thus the development of manufacturing has not always proceeded at an even pace, and at certain periods some branches of manufacturing have lagged behind and others have forged ahead. This uneven rate of growth is shown by our second measure of relative changes in manufacturing development. For selected benchmark years, total capital in each minor industry is expressed as a per cent of total capital in all

²⁵ In Clarence Long's investigation there is a trough in 1917-1919 and a subsequent peak in 1924-1927. (*Building Cycles and the Theory of Investment* [Princeton University Press, 1940], p. 136, Table 11, quoted in Simon Kuznets' "Swings in the Rate of Secular Growth," Work Memorandum No. 37, p. 22, National Bureau of Economic Research, 1952).

TABLE 5

Annual Average (Geometric) Rate of Change in Total Capital (1929 Prices) between Benchmark Years
All and Fifteen Major Manufacturing Industries, 1880-1948 (Per Cent)

	1880- 1890	1890- 1900	1900- 1904	1904- 1909	1909- 1914	1914- 1919	1919- 1929	1929- 1937	1937- 1948
All manufacturing industries	8.8	5.3	6.5	6.4	3.0	4.6	3.2	-1.6	3.7
Food & kindred products	7.4	7.4	5.8	3.5	3.4	3.1	2.4	-0.5	2.2
Textiles & their products	7.3	4.5	4.3	5.9	2.2	5.5	2.0	-4.6	2.5
Leather & leather products	6.9	3.4	6.2	5.0	-0.1	0.9	-1.5	-5.0	0.5
Rubber products	13.7	7.5	5.1	8.4	13.8	21.6	4.9	-4.0	5.4
Forest products	8.7	3.9	3.7	6.2	-0.7	-1.9	2.6	-5.7	1.7
Paper, pulp, & products	8.3	8.6	8.9	8.4	4.5	4.1	3.9	-1.0	2.5
Printing, publishing, & allied industries	12.5	5.6	3.5	6.1	2.7	1.5	5.8	-1.1	0.7
Chemicals & allied products	8.8	6.2	6.0	6.2	6.3	6.0	4.3	-0.8	4.9
Petroleum refining	15.1	2.6	5.9	5.2	11.0	20.1	16.0	0.8	5.3
Stone, clay, & glass products	10.1	6.1	10.9	9.1	2.0	-2.9	4.5	-3.3	1.4
Metals & metal products	10.4	5.1	9.3	8.0	3.6	7.1	1.2	-0.4	4.6
Iron & steel & their products	9.2	3.3	13.8	8.3	3.7	5.4	-0.1	0.1	3.9
Nonferrous metals & their products	9.1	8.9	6.2	11.3	-0.1	5.8	2.7	-0.1	1.1
Machinery, not including transportation equipment	10.9	5.2	7.6	6.2	3.3	5.4	1.0	-1.9	6.8
Transportation equipment	24.8	8.0	-1.0	11.2	11.8	20.1	3.4	0.7	4.5
Miscellaneous manufactures	10.0	4.1	7.2	8.8	4.7	1.1	9.1	-6.6	5.9

Source: Based on data described in Section 1.

TABLE 6

Alternating Periods of High and Low Rates of Change in Total Capital (1929 Prices)
Fifteen Major Manufacturing Industries Compared with All Manufacturing, 1880-1948*

	<i>High</i> 1880-1890	<i>Low</i> 1890-1900	<i>High</i> 1900-1904	<i>Low</i> 1909-1914	<i>High</i> 1914-1919	<i>Low</i> 1929-1937	<i>High</i> 1937-1948
Food & kindred products (1890-1900)							
Textiles & their products	1880-1890	(1900-1904)	(1904-1909)	1909-1914	1914-1919	1929-1937	1937-1948
Leather & leather products	1880-1890	1890-1900	1900-1904	1909-1914	1914-1919	1929-1937	1937-1948
Rubber products	1880-1890	(1900-1904)			1914-1919	1929-1937	1937-1948
Forest products	1880-1890	(1900-1904)	(1904-1909)	(1914-1919)	(1919-1929)	1929-1937	1937-1948
Paper, pulp, & products			1900-1904			1929-1937	1937-1948
Printing, publishing, & allied industries							
Chemicals & allied products	1880-1890	(1900-1904)	(1904-1909)	(1914-1919)	(1919-1929)	1929-1937	1937-1948
Petroleum refining	1880-1890	1890-1900	1900-1904	(1904-1909)	1914-1919	1929-1937	1937-1948
Stone, clay, & glass products	1880-1890	1890-1900	1900-1904	(1914-1919)	(1919-1929)	1929-1937	1937-1948
Metals & metal products	1880-1890	1890-1900	1900-1904	1909-1914	1914-1919	1929-1937	1937-1948
Iron & steel & their products	1880-1890	1890-1900	1900-1904	1909-1914	1914-1919	(1919-1929)	1937-1948
Nonferrous metals & their products							
Machinery, not including transportation equipment	1880-1890	(1900-1904)	(1904-1909)	1909-1914	1914-1919	1929-1937	1937-1948
Transportation equipment	1880-1890	1890-1900	1900-1904	1909-1914	1914-1919	1929-1937	1937-1948
Miscellaneous manufactures	1880-1890	1890-1900	(1904-1909)	(1914-1919)	(1919-1929)	1929-1937	1937-1948

* A date in parentheses indicates that the turning point for a given industry group differs from that for all manufacturing.

Source: Based on data described in Section 1.

TABLE 7

Per Cent Distribution of Total Capital (1929 Prices)
by Manufacturing Industry, Selected Years, 1880-1948

	1880	1900	1919	1948	
				<i>Excluding Net Investment in Emergency Facilities</i>	<i>Including Net Investment in Emergency Facilities</i>
All manufacturing industries	100	100	100	100	100
1. Food & kindred products	18.5	20.6	16.4	14.6	14.2
Bakery & confectionery products	1.0	1.5	2.4	1.6	
Canned products	0.3	0.8	1.0	1.5	
Mill products	6.7	2.5	2.1	1.0	
Packing house products	1.8	2.5	3.1	1.8	
Sugar refining	1.0	2.7	1.2	0.7	
Liquor & beverages	5.0	6.7	2.0	2.8	2.8
Nonalcoholic beverages	0.1	0.3	0.3	0.7	
Malt liquors & malt	3.9	5.9	1.6	1.0	
Wines	0.1	0.1	b	0.1	
Distilled liquors	0.9	0.4	0.1	1.0	
Tobacco products	1.5	1.5	1.6	2.1	2.1
Other food products	1.2	2.5	3.0	3.0	
2. Textiles & their products	20.6	16.4	14.5	9.2	9.0
Cotton goods	8.4	6.3	5.0		
Silk & rayon goods	0.7	1.0	1.2		
Woolen & worsted goods	4.0	3.2	2.0		
Carpets, floor coverings, etc.	0.8	0.6	0.4	0.4	
Knit goods	0.6	1.0	1.2	0.8	
Clothing	3.9	3.1	3.4	2.7	2.6
Hats, except cloth & millinery	0.3	0.3	0.3	0.1	
Men's & boys' clothing, except fur & rubber	3.0	1.9	1.9	1.3	
Women's clothing, children's & infants' wear, except fur & rubber	0.3	0.6	1.0	1.3	
Millinery	0.3	0.3	0.2	b	
Textiles, n.e.c.	2.2	1.2	1.2		

TABLE 7 (cont.)

				1948	
				<i>Excluding Net Investment in Emergency Facilities</i>	<i>Including Net Investment in Emergency Facilities</i>
	1880	1900	1919		
Textiles and their products (cont.)					
Cotton + silk & rayon + woolen & worsted goods + textiles, n.e.c.	(15.4)	(11.7)	(9.5)	(5.3)	
3. Leather & leather products	6.8	4.6	3.0	1.1	1.0
Boots & shoes	1.9	1.4	1.2	0.6	
Other leather products	4.9	3.2	1.8	0.5	
Leather, tanned, cur- ried, & finished	3.2	2.4	1.3	0.3	
Leather products, n.e.c.	1.8	0.8	0.5	0.2	
4. Rubber products	0.3	0.6	2.1	1.8	1.8
5. Forest products	17.6	12.9	6.8	3.8	3.7
Sawmills & planing mill products	10.7	7.7	4.3	2.4	2.3
Other wood products	6.9	5.2	2.5	1.4	1.4
Wooden containers	1.2	0.9	0.5	0.2	
Wood products, n.e.c.	5.7	4.3	2.0	1.3	
6. Paper, pulp, & products	1.9	2.6	3.3	3.3	3.3
Paper, pulp, & paper- board mills	1.6	2.0	2.5	2.2	
Paper bags, containers, & boxes	0.1	0.3	0.4	0.6	
Other paper products	0.2	0.3	0.4	0.5	
7. Printing, publishing, & allied industries	3.0	4.6	3.3	3.4	3.3
Book & job, including lithography	2.5	1.6	1.3	1.1	
Newspaper & periodicals	"	2.6	1.7	1.8	
Allied industries	0.5	0.4	0.3	0.5	

TABLE 7 (cont.)

	1880	1900	1919	1948	
				<i>Excluding Net Investment in Emergency Facilities</i>	<i>Including Net Investment in Emergency Facilities</i>
8. Chemicals & allied products	4.3	5.0	6.0	8.1	8.1
Chemicals proper, acids, compounds, etc.	1.5	1.7	2.2	2.4	
Fertilizers	0.6	0.7	0.7	0.3	
Allied chemical substances	2.2	2.7	3.1	5.4	
Drugs, medicines, & cosmetics	0.4	0.6	0.7	1.1	
Soaps & cleaning & polishing preparations	0.5	0.4	0.5	0.5	
Paints & varnishes	0.5	0.6	0.6	0.8	
Other chemical substances	0.8	1.0	1.3	3.0	
9. Petroleum refining	0.8	1.1	3.0	13.7	13.9
10. Stone, clay, & glass products	3.2	4.0	3.6	2.8	2.8
Cement, lime, & concrete products	0.2	0.6	1.1	0.9	
Clay & pottery products	1.4	1.8	1.2	0.5	
Glass & glass products	0.8	0.8	0.7	0.6	
Cut stone & products	0.7	0.6	0.3	0.1	
Stone, clay, & glass products, n.e.c.	0.1	0.2	0.3	0.7	
Metals & metal products	21.1	25.6	35.9	35.4	35.9
11. Iron & steel & their products	9.8	9.1	14.5	11.9	12.4
Iron & steel	7.9	6.9	11.4	8.7	
Blast furnaces, steel works, & rolling mills	7.1	6.0	9.0	5.6	
Ordinance & accessories	0.3	0.2	0.6	0.2	
Tin cans & other tinware			0.6	0.5	
Iron & steel, n.e.c.	0.5	0.6	1.2	2.4	
Metal building materials & supplies	0.3	1.0	1.7	2.1	

TABLE 7 (cont.)

	1880	1900	1919	1948	
				<i>Excluding Net Investment in Emergency Facilities</i>	<i>Including Net Investment in Emergency Facilities</i>
Iron and steel & their products (cont.)					
Hardware, tools, etc.	1.5	1.2	1.4	1.1	
12. Nonferrous metals & their products	2.4	3.5	3.9	3.0	3.2
Clocks, watches, & parts	0.2	0.3	0.2	0.2	
Jewelry, silverware & plating	0.6	0.6	0.7	0.3	
Smelting, refining, & alloying	0.7	2.0	2.4	2.1	
Nonferrous metal prod- ucts, n.e.c.	0.9	0.6	0.6	0.4	
13. Machinery, not including transportation equipment	8.6	11.0	12.0	13.4	13.2
Electrical machinery & equipment & radios	0.1	1.0	2.5	4.4	4.4
Agricultural machinery	2.2	1.9	0.9	1.6	
Office equipment	0.2	0.3	0.4	0.7	
Factory, household & misc. machinery	6.1	7.8	8.2	6.7	
14. Transportation equipment	0.4	2.0	5.3	7.0	7.2
Motor vehicles, complete or parts		0.4	4.2	5.2	5.1
Locomotives & railroad equipment	0.4	1.6	1.1	0.8	
Aircraft & parts			^b	1.0	
15. Miscellaneous manufactures	1.8	1.9	2.0	2.7	3.0
Professional, scientific, photographic, & opti- cal instruments	0.1	0.2	0.3	0.9	
Misc. manufactures, n.e.c.	1.7	1.7	1.7	1.8	

^a Not covered by the Census of 1880.^b Less than one-tenth of one per cent.

Source: Based on data described in Section 1.

manufacturing industries (Table 7). We have selected 1880 the first year for which reliable statistics are available, the beginning of the century, and years that closely follow the termination of World Wars I and II. For these particular years it is possible to distinguish 65 minor industries.

Even by 1900 the industries that had been among the first to be mechanized were losing ground to familiar commodities then newly produced by the factory system with mechanical power and manipulation and to newly developed products. Thus the textile, leather, and forest products industries failed to expand as rapidly as all manufacturing industries on the average. Capital in these three major industry groups constituted 45 per cent of all manufacturing capital in 1880 and 34 per cent at the turn of the century. Within these old industries new branches were emerging, particularly in textiles, as a result of the transfer of household activities to the factory. This was the case with women's, children's, and infants' clothing and knit goods, and these two minor industries had a better than average rate of expansion between 1880 and 1900.

The same sort of transfer explains the relative rise in food products; bakery products, canning, and slaughtering and meat packing were being rapidly shifted from the household to the market economy. Milling, on the other hand, which had been a factory process for many decades, declined sharply in relative importance during these two decades.

The largest relative expansion occurred in new industries that were still at the threshold of tremendous growth: transportation equipment; electrical machinery and equipment; metal building materials and supplies; smelting, refining, and alloying of nonferrous metals; cement, lime, and concrete products; paper bags, containers, and boxes; and rubber products. In the succeeding twenty-year period it was this very same group of industries together with petroleum refining and iron and steel that expanded rapidly — nearly doubling their share of manufacturing capital, from 15.5 per cent in 1900 to 29.9 in 1919. The old industries — textile, leather, and forest products — continued in a state of relative decline, accounting for a third of the total in 1900 and a quarter in 1919.

Some of the industries with a better than average rate of capital

expansion before 1919 had a less than average rate by 1948. This was true of the basic metal industries, both ferrous and nonferrous, and rubber tires and tubes. Some of the metal-using industries, on the other hand, such as electrical machinery and equipment including radios and television sets; automobiles; airplanes; office equipment; professional, scientific, and optical instruments; and metal building materials and supplies continued to expand at a better than average rate. However, by all odds the largest relative gains occurred in petroleum refining, while the increased share of chemical and allied products was also impressive.²⁸

The paper and printing industries accounted for about the same per cent of manufacturing capital in 1948 as in 1919. Food and kindred products as a group declined in relative importance, although the minor industries of canning and deep-freezing and tobacco products continued their capital formation at a faster rate than that for all manufacturing industries. The old established industries continued to wane, using only a seventh of all manufacturing capital in 1948 compared with a fourth in 1919. Indeed, the decline in leather and forest products had proceeded to the point where in absolute terms (constant prices) less capital was being utilized after World War II than after World War I. In textiles the rise of synthetic fabrics, which cannot be shown separately, failed to offset the relative and absolute loss of capital in the primary textile industries. Throughout this period the only textile industry of growing importance in terms of capital was the manufacture of women's, children's, and infants' clothing.

To summarize the trends in the stock of capital over this seventy-year period, the older industries such as textile, leather, and forest products have declined in importance while the newer ones such as the metal-producing and using industries, chemicals, and petroleum refining have increased in importance. Do these differential rates of growth help to explain differential movements in capital-output ratios? We shall explore this possibility after we establish the trends in the capital-output ratios.

²⁸ The inclusion of investment in emergency facilities in 1948 does not alter the basic trends.